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ALBERTA SOCIETY OF PROFESSIONAL BIOLOGISTS

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ASPB AND CAB-BC COLLABORATE ON ADAPTATION KNOWLEDGE STUDY (P.6)

ASPB
ALBERTA SOCIETY OF PROFESSIONAL BIOLOGISTS

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BIOS

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... notes from the E.D.

The summer of 2016 has been a relatively quiet one at the ASPB office. Society staff have taken the opportunity to clean up our filing system and prepare for new initiatives which include, of course, an expanded membership with the inflow of the technologist stream.

The Registration Committee, chaired by Jeremy Reid, P. Biol., has been kept busy reviewing applications for membership in all categories (we have had over 76 applications since the Society's annual meeting in April, and each has to undergo a thorough vetting prior to acceptance.) The Practice Review Committee, chaired by Carol Engstrom, P. Biol., has been engaged in reviewing the continuing competency program (CCP) and is working to develop an auditing system for the CCP to ensure that it continues to reflect the requirements set out in the ASPB regulation.

Many Albertans will be happy to see the end of this summer. Weather patterns and events have stretched the patience of folks who must deal with outdoor work, and of course the impacts of the horrendous fire in and around Fort McMurray were felt province-wide. The economic downturn caused by the collapse of the global oil market has affected everyone, and especially our member biologists who are (or were) directly employed in the oil and gas industry.

Because of those negative economic pressures, the Society will not be mounting the traditional two-day conference next spring. To keep costs down - especially attendance costs like registration and overnight stays - we are planning a one-day event in Calgary that will focus on areas of practice that are of key importance to the membership. These will include sessions for wildlife practitioners and updates for biologists working in reclamation and remediation. Planning for this event is at the early stages, and more information will follow; despite the tight focus and limited duration, plans will still include networking opportunities for registrants!

In the face of stressful times such as these, we must never forget that the work of biologists is all about the life forms that sustain us, and as such our work is essential to the processes of recovery and planning for a healthy future. Keep up the good work!

Jennifer Sipkens, ASPB Executive Director

Under review:
The Alberta Wetland Policy Implementation

This practice standard is in the process of being reviewed by the councils and boards of directors of the ten regulatory organizations involved in the development and implementation of the practice standard. Once this has been completed, the ASPB will send out the final version of the practice standard through email and will post it on the ASPB website.

The draft version is available on the downloads page of the ASPB members' only section of the website – please review this document if you are a wetland practitioner. It is the responsibility of each professional to ensure they maintain a current knowledge of all acts, policies, procedures and guidance documents.

If you have any questions about the practice standard, please email the executive director at *jsipkens@aspb.ab.ca*.

On the cover...

Dr. Jian Zhang, P. Biol., with Alberta Innovates Technology Futures, in the field. His article on page 5 of this issue discusses his work with bioremediation, as "the use of naturally occurring processes in soils or groundwater, taking advantage of plants (phytoremediation) or microorganisms (micro-remediation) to degrade specific contaminants."

The ASPB reaches out to budding biologists

Student outreach at the Alberta Society of Professional Biologists has been yielding positive results, growing the Student Member roster from fewer than 10 in 2012 to over 110 by the fall of 2016. A number of BIT and P. Biol. members have played an active role as members of the Student Outreach Committee, along with increased visits to colleges and universities by staff over the last couple of years.

We are looking for short "first person" articles about what biologists do for a living, how they got there, how to choose career paths, and any tips for students for when they graduate and need to find work.

This last summer and fall was no exception: the ASPB's Executive Director, Jennifer Sipkens, presented her yearly "Introduction to Regulatory Bodies" presentation to Dr Mary Reid's environmental science class at the University of Calgary in August, and is planning another information session at the U of C this fall, as well as maintaining strong relationships with the University of Lethbridge and Lakeland College in Vermillion. Administrative Assistant Christina Golubic attended outreach events at the University of Alberta and the University of Lethbridge in the late summer.

Eggs on rebar

The Student Outreach Committee will be busy this fall, and is looking for additional volunteers (please see the website in the volunteers section to learn more). Committee members are interested in promoting membership and the benefits of being an ASPB member, leading to career and professional opportunities for students. The ASPB Editor is also looking for written (and photographic!) contributions to *BIOTA*, the periodical E-News publication created by the ASPB especially for students. We are looking for short "first person" articles about what biologists do for a living, how they got there, how to choose career paths, and any tips for students for when they graduate and need to find work. *(See article in this issue by Sara Smith, MSc.)*

Just for fun, the ASPB ran an *Instagram* photo competition this last summer, focused on summer jobs and activities. Over a dozen photos were submitted; the winning photograph, by Emily Cribb, appears with this article. Ms Cribb is in her first year of a MSc in ecology at the University of Calgary, where she is studying the effect of the herbicide *diquat dibromide* on various stress endpoints in brook stickleback and fathead minnows. These yet-unidentified eggs are attached to a piece of re-bar that she uses for her temperature probes; this one has been in the water since the end of June and is checked every week or so (these eggs were found August 17).

ASPB Mentoring Program

"Show me a successful individual and I'll show you someone who had real positive influences in his or her life. I don't care what you do for a living - if you do it well I'm sure there was someone cheering you on or showing the way. A mentor." ~ Denzel Washington

Do you want to help someone realize his or her own potential?
Do you want to increase your knowledge and have a professional biologist to reach out to?
Do you want to have fun and maybe make a new friend?
Do you want to feel like you did something that matters?

If you answered yes to any of these questions, the ASPB Mentoring Program might be for you!

The program offers an opportunity to share knowledge and ideas among new and long-time members. It also allows protégés to learn new skills and knowledge, while mentors can develop leadership skills and maybe learn things from their protégés as well!

The ASPB mentoring program will be accepting applications between January 1st and February 28th. For more information about the program please visit our website: www.aspb.ab.ca/mentoring-program

Next generation genomic applications in the areas of contaminated sites remediation and reclamation

By Dr. Jian Zhang, P. Biol., Alberta Innovates Technology Futures

It is clear that resource extraction can impose pressure on the environment. Environmental impacts from resource-based (e.g., oil and gas and mining) industries in Canada have generated international headlines, many of which damage Alberta/Canada's reputation to some degree. For example, over the past 15 years in Alberta, the average number of oil and gas wells drilled has exceeded 10,000 wells per annum. This has resulted in a large aggregate area requiring reclamation and remediation, with the primary contaminants including polycyclic aromatic hydrocarbons (PAHs) and salts. Assuming an average clearing of 1 ha per well site, the cumulative area of existing wells in the Boreal Forest Natural Region, as of 1997, was estimated to be over 886 km² (Alberta Center for Boreal Studies 2001, http://www.borealcentre.ca). Today, the area would be well over 1,000 km². In addition, there are over 300 orphan sites in Alberta, which require reclamation and/or remediation (Pryce 2009).

"Applied Genomics for Environmental Remediation in Canada (AGERC) is a project that seeks to enhance the efficiency and speed of existing bioremediation and reclamation systems for metal/hydrocarbon contaminated sites using genomic approaches."

Reclamation refers to the process of converting disturbed land to its former state or to other productive uses. Remediation, on the other hand, refers to the improvement of a contaminated site to prevent, minimize, or mitigate real or potential damages to human health and/or the environment (Government of Canada 2008). Techniques for *ex-situ* remediation require the excavation and transport of contaminated soils and are expensive and environmentally disruptive. Conversely, *in-situ* treatment, including bioremediation, has become an attractive option in recent years due to reduced costs and additional disturbances to already disturbed or contaminated sites. Here, bioremediation refers to the use of naturally occurring processes in soils or groundwater, taking advantage of plants (phytoremediation) or microorganisms (micro-remediation) to degrade specific contaminants, e.g., hydrocarbons. Ultimately, bioremediation depends on the interactions among plants, microorganisms, water, and soil to reduce contamination (USACOE, 1997).

The Alberta Biodiversity Monitoring Institute (ABMI) has begun to develop methods to assess the ecological condition (sometimes referred to as "ecological health") of disturbed areas. Although plant species have been identified that can establish and grow in a wide range of contaminated soils, the characteristics and mechanisms that are responsible for these abilities are mostly unknown. Even less is known about the plant-associated microbial communities, primarily bacteria and fungi, in these sites, possible synergistic effects among plants and microbial communities, or the contribution of symbiotic plant-microbe interactions. To accelerate existing remediation and monitoring work, new approaches, such as genomics (ecogenomics and metagenomics), are needed to better understand the interaction between plants and microbes so that more optimal and efficient bioremediation systems can be developed. Metagenomics involves sequencing of a mixture of DNA extracted from a community of organisms, including plants and microbes. Based on the DNA sequences, the identity of species in a particular ecological community can be identified, which is particularly useful for microbial communities, since the majority of microbes (as high as 99%) cannot be cultured under laboratory conditions. Applied Genomics for Environmental Remediation in Canada (AGERC) is a project that seeks to enhance the efficiency and speed of existing bioremediation and reclamation systems for metal/hydrocarbon contaminated sites using genomic approaches.

Massive quantities of genomic (metagenomic and ecogenomic) data generated from successful bioremediation (reclamation) sites in Alberta/Canada will accelerate the remediation of contaminated sites by targeted supplementation of plants and microbes to existing communities or by *de-novo* design of plant-microbe communities. AGERC was designed to exploit and enhance beneficial, purpose-designed-plant-microbe communities towards the remediation of industrial sites using applied genomics tools. Hence, this project has the potential to improve Canada's capacity on monitoring biodiversity, which is a major component of the National Biodiversity Strategy and Action Plan. AGERC is hoping to achieve the objectives laid out in the proposal, which will make Canada a leader in the industrial use of plant-microbes communities for bioremediation and reclamation of contaminates sites and effective environmental and ecological monitoring of disturbed industrial sites.

The overall objectives of AGERC are to exploit and enhance beneficial plant-microbe-interactions in the remediation/reclamation of industrial hydrocarbon-polluted sites using new generation applied genomics tools. Specifically, AGERC will achieve the following goals:

(continued on page 5)

Next generation genomic...*(continued from page 4)*

1. Perform genomics characterization of select plant microbial interactions implicated in the remediation of contaminated sites in Alberta (e.g., well sites, reclaimed areas, and tailing ponds) as well as in pristine control locations.
2. Establish a metagenomic database for selected remediation sites, assess selected populations to analyze the symbiotic signatures among plant and microorganism populations, and re-engineer an optimized system, which will enhance the remediation process.
3. Develop a database to illustrate and connect the genetic potential of microorganisms, functional gene expression, and biochemical pathways that exist naturally within disturbance sites (well sites, reclaimed oil sands tailing ponds, etc.).
4. Use the genomics data in 1, 2, and 3 to design plant-microbial interaction systems that would improve the cost and time efficiencies of conventional remediation processes.
5. Conduct ecogenomics analyses and describe ecological conditions at pristine sites, so that these can be used as reference conditions to which conditions at disturbed sites are compared. Provide more accurate monitoring tools for biodiversity surveillance.
6. Generate an Alberta native plants and microbe's molecular ID database based on genomic sequences, which can provide accurate information to better manage native plant and microbial resources used in remediation and habitat restoration efforts.
7. Establish a pool of demonstration pilot remediation/reclamation sites to validate the effectiveness of genomic/metagenomics-based tools and enhanced plant/microorganism communities when used on environmentally-sensitive sites.
8. Develop and commercialize biomarkers and monitoring techniques to track the progress of bioremediation strategies.

In summary, next generation sequencing technology has proven to be a powerful tool for obtaining better understanding plant-microbial communities and their interactions in various environmental settings. Ultimately, we hope that this approach will be beneficial towards remediating and reclaiming contaminates sites in Alberta and Canada, thereby enhancing our reputation internationally.

References:

Alberta Center for Boreal Studies 2001, http://www.borealcentre.ca
Pryce, 2009, Orphan Well Association 2009/10 Annual Report

Author Biography:

In 1994, curiosity about science and Israel drove Jian to the Weizmann Institute of Science at Rehovot to start his graduate school in molecular genetics and biotechnology after finishing his undergraduate degree in Beijing and working at the Chinese Academy of Science for 4 years. He then moved to the University of Guelph, Ontario, in 1998 to complete his Ph.D. and work briefly as a post-doctoral researcher in the field of Environmental Biology at the University of Guelph. In 2005, he joined the Alberta Research Council (now Alberta Innovates Technology Futures) and started his long-time adventures in genetic engineering, improving food safety, environmental related studies, functional food, and new materials research.

The Genetic Basis of Behaviour in Fish

by Sara Smith, MSc.

Photo by Chad Tamis

My name is Sara Smith and I am a doctoral student at the University of Calgary under the supervision of Dr Sean Rogers and Dr Rowan Barrett. I completed my undergraduate degree in marine biology and oceanography at the University of Victoria, finishing my course work at the Bamfield Marine Sciences Centre, where I studied the homing behaviour of tidepool sculpin.

When I graduated, I was hired to help set up and open Ripley's Aquarium of Canada, where I was responsible for the world's largest public jellyfish aquarium. I would also SCUBA dive with sand tiger sharks, interact with octopuses, and hand feed wolf eels to monitor health, behaviour, and disposition at Ripley's. These interactions, along with caring for the jellyfish habitats, allowed me to observe animal behaviours in a way I would otherwise never have been able to experience.

I am deeply interested in animal behaviour, but especially in the behaviour of fishes and how contemporary climate change may affect these behaviours in the coming years. Temperature is currently undergoing tremendous fluctuations in the natural world, making aquatic habitats much more variable and extreme. My research focuses on the genetic basis of behaviour in marine and freshwater stickleback, a small fish which shows an incredible adaptive radiation across habitats.

In particular, I'm looking at how these populations may respond to - and evolve - in the face of temperature shifts. To address this, I'm assessing thermal tolerance and preference, as well as social behaviours, in wild- and lab-raised generations of stickleback. This allows me to see how their tolerance for warmer (and colder) temperatures is inherited and evolves, as well as what temperatures they prefer to live in and how their behaviour may be affected.

I am also constructing a genetic map to see which sections of DNA correlate with variation in these phenotypes. Understanding how this variation in temperature may affect fish populations on a genetic level will help us reveal the basis to key behaviours and to better understand the implications of climate change on fish populations.

Sara Smith, MSc., produced this short article for the ASPB's student newsletter, BIOTA. We felt her accomplishments were notable and her enthusiasm was contagious.

Mobilizing decision-relevant adaptation knowledge through the roles of professional biologists in western Canada

The presentation on the following pages is the result of a collaborative initiative between the British Columbia College of Applied Biology (Pierre Ischetti) and the Alberta Society of Professional Biologists (Jennifer Sipkens), with ESSA Technologies Ltd. (Marc Nelitz, Patricia de la Cueva Bueno and Jimena Eyzaguirre) and Beardmore Consulting LLC (Ben Beardmore). The collaborators acknowledge funding support from Natural Resources Canada, along with the hundreds of biologists who took time and attention to respond to the survey. A focus group provided thoughtful guidance and input, including Calum Bonnington (RPBio), Chris Maundrell (RPF, RPBio), Lisa Christensen (RPBio), and Miriam Isaac-Renton (RPBio). Johanna Wolf (PhD) of the British Columbia Climate Action Secretariat and Pamela Kertland of Natural Resources Canada also provided valuable advice throughout.

Introduction/Context

Professional Biologists and Biology Technologists in western Canada have a unique role in preparing for the impacts of climate change. These professionals perform several functions within which they may be able to consider the effects of a changing climate, including environmental assessment, ecosystem restoration, natural resource, wildlife and fisheries management, as well as conservation planning, among other practice areas. Recognizing this important role, the College of Applied Biology (the College) and the Alberta Society of Professional Biologists (ASPB) support deepening engagement around climate adaptation among its members. As such, these organizations undertook this research with the aim of increasing the uptake of adaptation knowledge among biologists while conducting their work.

Approach

To achieve this aim, this research involved three components:

1. characterizing biologists' needs, perceptions of climate impacts, and experience in adaptation through a survey of members of the College and ASPB (see **Part 1** results);
2. developing an inventory of adaptation knowledge generated by others with an emphasis on projects funded by Natural Resources Canada (see **Part 2** results); and
3. preparing written guidance to highlight how relevant adaptation knowledge could be accessed by biologists for varied purposes (see **Part 3** results).

Figure 1: Attitudes of professional biologists towards climate adaptation

HIGHLY MOTIVATED
14%
• Individuals in this group mostly included practicing biologists (64%), were extremely motivated (94%), and often or always encountered relevant situations in their day-to-day work (100%).
• A large proportion attribute climate change to human influences (93%) and had the largest proportion with graduate degrees (73%).
• Most believe it urgent to consider climate impacts in the next 5 years (85%) and that climate impacts were somewhat or much more importance to address than other stressors (51%).
• Had the most varied representation across organizations, including academia (11%), local government/communities (7%), non-governmental organizations (14%), and provincial government (9%), with a a significant proportion working in private consulting (42%).
CONCERNED
45%
• On average, this group was very motivated (70%)to act with a slightly lower rate of encountering situations in their work (82%, sometimes or often).
• Many attribute climate change to human influences (80%), but others believe that the cause of climate change is equally attributable to human and natural influences (18%).
• Most believe it urgent to consider climate impacts within the next 5 years (86%), though most respondents tended to rate climate impacts as equally important as other issues (58%).
• The majority tend to work in private consulting (52%), for a provincial government agency (18%), in the resource development industry (7%), or with the federal government (6%).
INTERESTED
38%
• On average this group was moderately motivated to act (55%) and were exposed to situations sometimes or rarely (86%).
• Although a strong contingent attributed climate change to human influences (65%), there was a significant proportion that believed in equal human and natural attribution (26%) or mostly natural influences (9%).
• On average, the urgency and importance of situations were rated lower than the other more motivated groups.
• The group was dominated by practising biologists (82%) and included the largest contingent of students or biologists in training (16%).
• This group largely works in private consulting (71%), for a provincial government agency (9%), or in the resource development industry (6%).
SKEPTICAL
3%
• Although many in this group were very motivated to act (42%), it had the most divergent levels of motivation ranging from not at all (6%) to extremely motivated (11%) and comparably divergent rates of encounter with situations ranging from never (22%) to often (35%).
• A large proportion believed in human attribution of climate change (65%), but this group also had the largest proportion attributing climate change to natural influences (18%) or indicating that it is not occurring (5%).
• This group had the lowest urgency ratings with many indicating no urgency (45%) and the majority that believed impacts of climate change were somewhat or much less important to address than other impacts (57%).
• This group had the largest proportion (90%) of non-practicing biologists (i.e., withdrawn, retired, or on leave).

Part 1: Survey of professional biologists

The survey of biologists was completed by 580 respondents; 81% were associated with the College and 19% with ASPB. An analysis revealed four types of respondents, largely aligning along a spectrum of motivation and belief about the underlying cause of climate change (see Figure 1). Biologists described 552 situations within which they would or could consider the impacts of climate change. An analysis of these situations revealed a narrower set of impact themes, natural resource clusters, and sector groupings that were then used to develop a typology of adaptation context. This typology was used to further simplify the full range of situations into a narrower set of eight generalized scenarios to represent the diversity of situations described by respondents (see Figure 2). The survey also explored the strength with which external, internal organizational, and personal barriers might inhibit the ability of biologists to consider the impacts of climate change in their work (see Figure 3).

Figure 2: Generalized situations in which professional biologists consider the impacts of climate change

Fish and Fish Habitat (14%)
Focused around impacts on freshwater conditions and how changes will specifically affect fish habitats and reliant fish species. This scenario was most relevant to stakeholders involved in the fisheries sector.

Coupled Freshwater -Terrestrial Ecosystems (21%)
Involved impacts on freshwater conditions, seasonal changes in water supplies, and water quality that have the potential to impact freshwater and the coupled terrestrial ecosystems, especially the habitats and species reliant on water. Most relevant to fisheries, recreation/tourism, resources conservation, and subsistence sectors.

Freshwater and Marine Ecosystems (11%)
Concerns stem from a diverse range of impacts on water and the hydrologic cycle that affect both freshwater and marine environments. Most relevant to fisheries, culture and subsistence, recreation and tourism, resource conservation, and human health sectors.

Marine Ecosystems (12%)
Involved impacts on habitat/species shifts and ocean acidification. Affected resources include marine/coastal waters, fish species, and biodiversity more broadly. Fisheries, resource conservation, and recreation/tourism were identified as the most affected sectors.

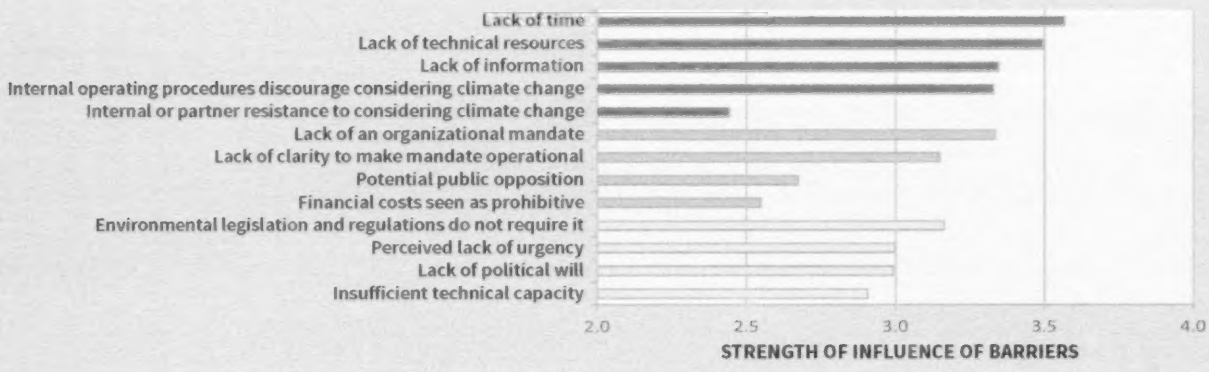
Terrestrial Habitats and Species (13%)
Focused on the anticipated shifts in wildlife habitats and species that will ultimately affect biodiversity, invasive species, and endangered species in terrestrial environments. Relevant to the forestry and resource conservation sectors, though not consistently across situations.

Forested Ecosystems (12%)
Involved physical impacts on forest ecosystems (e.g., wildfire, species/habitat shifts) and was relevant to a broad range of resources including the timber/non-timber forest products, forested lands, and a diversity of terrestrial species. Most relevant to the forestry and resource conservation sectors.

Dryness/Heat and Terrestrial Ecosystems (13%)
Unique focus on the impacts of drier and hotter conditions leading to increased wildfire, changes in growing seasons, and soil moisture deficits among others, with diverse impacts on forest ecosystems. Most relevant to the forestry, resource conservation, and recreation/tourism sectors.

Ecosystems and Reliant Human Uses (6%)
Included the most diverse range of impacts on freshwater and terrestrial environments (not marine), as well as the most cross-cutting range of resources affected by those impacts. Had a strong and consistent emphasis on a wide range of human uses/sectors affected by the physical impacts of climate change, including agriculture/ranching, resource conservation, culture/subsistence, forestry, industrial/commercial, recreation/tourism, and fisheries. This human-centric focus was in contrast to the other scenarios which tend to be ecosystem-centric.

Figure 3: Perceived barriers to climate adaptation faced by professional biologists



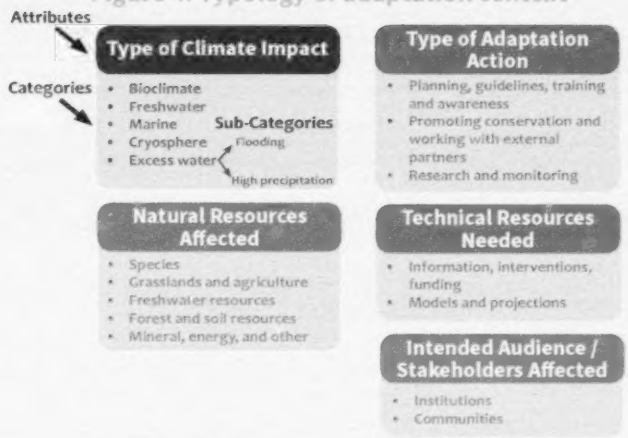
Part 2: Adaptation knowledge Inventory

An inventory of adaptation knowledge products and resources was developed to provide biologists with a summary of existing adaptation tools, data, and information that could be used to address adaptation needs in their day-to-day practice. The inventory includes 145 entries. Resources were categorized using a typology of adaptation context that was developed based on results from the survey, as well as some basic details describing the information source (see Figure 4).

Part 3: Development of climate adaption notes

A series of "climate adaptation notes" were prepared to disseminate research findings.

Figure 4: Typology of adaptation context



Climate Adaptation Note #1 summarizes key findings from the survey of biologists.

Climate Adaptation Note #2 provides information to professional biologists interested in building their basic capacity to adapt by directing them to the climate data, information and tools available to support natural resource planning and environmental management.

Climate Adaptation Note #3 provides information to professional biologists interested in learning about adaptation knowledge available to support conservation and ecosystem restoration in a changing climate.

Key Findings

This project revealed five key findings that have implications on how biologists can be better supported to improve the practice of climate adaptation in their day-to-day work.

1. Survey results suggest that individuals may be more motivated to act if they understand the scientific consensus that the current pattern of warming is mostly attributable to human activities.
2. The survey revealed four distinct audiences (highly motivated, concerned, interested, and skeptical) within which there will be different levels of effort, forms of engagement, and types of information required to support climate adaptation.
3. Despite the 552 specific situations described in the survey, an analysis revealed eight generalized scenarios; guidance and support can be targeted to support biologists across these scenarios.
4. A qualitative examination of the types of situations being described revealed there remains some confusion between climate change mitigation and climate change adaptation; adaptation may be aided by clarifying these terms.
5. An analysis of a wide range of external, internal organizational, and personal barriers showed that external barriers were rated as most strongly inhibiting biologists; it will be helpful to support biologists by minimizing these external barriers.